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A Report of Some Investigations on the Corn Insects of Puerto Rico
By BERNARD A. APP

New Bird Records and Some Notes for the Virgin Islands
By HARRY A. BEATTY

New Coleoptera from Puerto Rico
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Studies on the Mosaic of Peppers (*Capsicum Frutescens*) in Puerto Rico
By ARTURO ROQUE and JOSÉ ADSUAR

Germination Failures of the Magnolia in Puerto Rico
By MELVILLE T. COOK

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A REPORT OF SOME INVESTIGATIONS ON THE CORN INSECTS OF PUERTO RICO

By Bernard A. App, U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine [1]

During the period August 1935 to June 1936 studies were made by the Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture on insects attacking growing corn in Puerto Rico. These studies were financed from a special fund provided by the Department for the purpose and were conducted in cooperation with the experiment station of the United States Department of Agriculture at Mayagüez and the substation of the Agricultural Experiment Station of the University of Puerto Rico at Isabela.

As a result of these studies the following four species of insects were determined to be of prime economic importance to the corn crop of Puerto Rico: The corn leafhopper (*Peregrinus maidis* Ashmead), the otitid (ortalid) fly *Euxesta stigmatias* Loew infecting the ears, the fall armyworm (*Laphygma frugiperda* (A. and S.)), and the corn earworm (*Heliothis armigera* (Hbn.)). The corn leaf aphid (*Aphis maidis* Fitch) and the sugarcane borer (*Diatraea saccharalis* (F.)) were found in varying numbers, but little damage by them was noted. Control experiments were conducted with the fall armyworm and the corn earworm.

Because of the tropical climate and the varied topography of the island, there is wide variation in rainfall, this ranging from 30 to over

[1] Sincere appreciation is due to H. Atherton Lee, Director of the Agricultural Experiment Station at Mayagüez, for providing land and assistance, to R. L. Davis, agronomist at the station, who provided seed and gave valuable suggestions for growing the crops under Puerto Rican conditions, and to Luis A. Serrano, director of the Isabela substation of the Agricultural Experiment Station of the University of Puerto Rico, who provided land and seed and gave much valuable assistance at Isabela.

100 inches annually in different locations. The average variation between mean summer and mean winter temperatures is about 5 Fahrenheit degrees. Corn can be grown at all seasons of the year in locations where there is sufficient rainfall, and can be grown at any time in those areas that have been adapted to irrigation. Therefore corn in all stages of development can be found at any time. There was also found to be a great overlapping of the generations of corn insects, as eggs, young in all stages of development, and adults could be found at the same time in the same field.

THE CORN LEAFHOPPER

Peregrinus maidis Ashmead

In a survey of the island made in September and October 1935 no field was found in which the corn leafhopper was not present, and little difference in abundance was noticed in the different sections of the island. Fields averaged from 5 to 83 percent of the plants infested. Large numbers of these insects develop in the whorls of young plants and around the ear buds of older plants. Their feeding causes many young plants to wither and die, but the damage to older plants is not apparent. The greatest importance of the corn leafhopper is in the fact that it is the vector of corn yellow stripe disease, to which native varieties of corn are resistant but the exotic varieties very susceptible.

Euxesta stigmatias Loew

The larvae of the dipteron *Euxesta stigmatias* were found infesting the ears of corn in the roasting-ear stage. A large majority of the ears in fields in all sections of the island were infested. The eggs of this fly are deposited on the silks of the ears. The young larvae hatch in 2 to 4 days and feed for a short time in the silks, later working down into the developing grain. The tips of many ears are damaged and often entire ears are destroyed. The greatest damage probably consists in the unsightly appearance and malodorous condition imparted to roasting ears. The fly may pass through a complete generation in 18–24 days. Certain observations on this insect were presented in a previous publication.[2]

[2] App, Bernard A. *Euxesta stigmatias* Loew, an Otitid Fly Infesting Ear Corn in Puerto Rico. JOUR. AGR. UNIV. PUERTO RICO 22 (2): 181–188, illus. 1938.

THE FALL ARMYWORM

Laphygma frugiperda (A. and S.)

The larvae of the fall armyworm were found to be abundant in all sections of the island and present at all seasons. The eggs of this insect are laid in a mass on the leaves of young corn plants. The newly hatched larvae feed on the leaves, later moving into the whorl, where they consume a large quantity of leaf surface, often destroying the entire whorl and killing the plant. Eggs are also deposited on older plants and the developing larvae feed in the young ears, often entering from the side and between the leaf sheath and the ear. The average developmental period for 53 individuals raised in the laboratory from egg to adult was 35.6 days, so it is believed that many generations occur in a single year. Many larvae of this insect were observed to develop on malojillo grass (*Panicum purpurascens* Raddi), and severe damage was noticed in a field of corn that had previously been in grass. In this field the partly grown larvae attacked the young corn in cutworm style.

CONTROL MEASURES

Poisoned Bait.—In the case of partly grown larvae attacking corn after the manner of cutworms, an application of standard poisoned-bran bait gave good results. Paris green was used as the toxic agent in the bait.

Dusts.—Three different experiments were conducted to test the effectiveness of dusts for the control of the fall armyworm. All were applied with a large plunger-type hand duster having a short extension pipe ending in a fan-shaped attachment that directed the dust into the whorl of the young plants. About 8.5 pounds of dust per acre was required for small plants and as much as 18 pounds per acre for larger plants. In November 1935, at Mayaguez, four different dusts were tested in a randomized block arrangement replicated four times. Each plot was 10 by 15 hills in size and averaged about 1,000 plants per treatment. Three applications were made at 10-day intervals beginning November 9, when the plants were about 15 days old, and ending November 29, after which time it was thought that further dusting was impractical. Infestation counts were made on December 10, 1935, and the results are shown in table 1.

Because of the low percentage of control obtained in the previous test some changes were made in the experiments conducted during March

TABLE 1. *Efficacy of various dusts for the control of the fall armyworm. Mayagüez, P. R., November–December 1935*

TREATMENT	PLANTS	PLANTS INFESTED	CONTROL [1]	PLANTS BURNED
	Number	*Percent*	*Percent*	*Percent*
Lead arsenate and talc 1 : 4	1,116	31.0	53.5	19.9
Lead arsenate and talc 1 : 9	1,049	32.7	51.0	17.4
Pure dusting sulfur	973	59.0	11.5	0
Derris and talc 1 : 4	1,054	65.7	1.5	0
Check	1,051	66.7	—	—
Required significant difference for odds of 19 to 1		8.00		
Required significant difference for odds of 99 to 1		11.22		

[1] Percent controls computed from the formula $\frac{X - Y}{X} \times 100$, where X equals the percent infested in the check plots and Y equals the percent infested in the treated plots.

and April 1936. Experiments were conducted at Mayagüez and Isabela, and were each replicated 5 times. The plots at Mayagüez were 5 by 15 hills in size, totaling about 370 plants per treatment. At Isabela, where the corn was planted in drill rows, the field was divided into five blocks subdivided into plots running the length of the field. Treatments were applied to a single row in each plot. A buffer row of untreated corn was left on each side of the treated row. Each treated row contained about 140 plants, making approximately 700 plants per treatment. Dusting was done at weekly instead of 10-day intervals and was continued until the plants began to tassel. Sulfur was omitted from this test because it had failed to show significant results in the November-December trials and because of its high cost in Puerto Rico. The lead arsenate in the proportion of 1 part to 4 of talc was also omitted, since the results obtained in the previous experiment were no better than those obtained with the mixture with less arsenate. Derris was included but made slightly stronger by using 3 parts of talc to 1 of derris (4 percent rotenone) to give about 1 percent of rotenone in the dust. Barium fluosilicate in the proportion of 1 part to 9 of talc, and magnesium arsenate at the same dilution, were included in these tests. Table 2 shows the results of the tests at Mayagüez and Isabela during March

and April. In these trials the dusts were applied at weekly intervals, at Mayagüez beginning March 18 and ending April 15, and at Isabela beginning March 23 and ending April 13.

An analysis of the variance of the three experiments for the control of the fall armyworm is given in table 3. All three experiments showed some highly significant differences among the treatments. The required differences necessary for two means to differ significantly were computed and recorded in tables 1 and 2. In table 1 it is seen that there were no real differences between the results with derris and with sulfur and in the check. The two mixtures of lead arsenate show highly significant differences from the check but do not differ significantly from one another. In the experiments at Mayagüez and Isabela completed in June 1936 all the treatments show a highly significant difference from the check with lead arsenate, showing a significant advantage over the other materials. The somewhat better control obtained in April may be due to dusting at weekly rather than at 10-day intervals. All mixtures of lead arsenate burned some of the plants, but no serious damage occurred. Barium fluosilicate burned the plants rather severely, killed some of them, and appeared to stunt the growth of others.

TABLE 2. *Efficacy of dusts for the control of the fall armyworm, Puerto Rico, March–April, 1936*

TREATMENT	EXPERIMENT AT MAYAGÜEZ				EXPERIMENT AT ISABELA			
	PLANTS	PLANTS INFESTED	CONTROL	PLANTS BURNED	PLANTS	PLANTS INFESTED	CONTROL	PLANTS BURNED
	Number	*Percent*	*Percent*	*Percent*	*Number*	*Percent*	*Percent*	*Percent*
Lead arsenate and talc 1 : 9	392	8.4	88.2	25.6	753	22.8	70.6	35.7
Barium fluosilicate and talc 1 : 9	376	23.9	66.4	32.5	713	35.8	53.9	64.7
Derris and talc 1 : 3	371	38.2	46.3	0	745	49.9	35.7	0
Magnesium arsenate and talc 1 : 9	383	58.2	18.3	0	714	60.3	22.3	0
Check	359	71.2	—	—	714	77.6	—	—
Required significant difference for odds of 19 to 1		8.40				8.12		
Required significant difference for odds of 99 to 1		11.57				11.19		

TABLE 3. *Analysis of variance of the efficacy of dusts for the control of the fall armyworm in Puerto Rico, 1935–1936*

SOURCE OF VARIATION	LOCATION AND DATE OF EXPERIMENTS					
	MAYAGÜEZ NOVEMBER 1935		MAYAGÜEZ APRIL 1936		ISABELA APRIL 1936	
	DEGREES OF FREEDOM	MEAN SQUARE	DEGREES OF FREEDOM	MEAN SQUARE	DEGREES OF FREEDOM	MEAN SQUARE
Blocks.....	3	17.03	4	78.20	4	189.85
Treatments.	4	1,262.24*	4	3,198.50*	4	2,259.27*
Error.....	12	26.98	16	39.22	16	36.65

* Highly significant.

THE CORN EARWORM

Heliothis armigera (Hbn.)

Earworms were found to be abundant in Puerto Rico and usually were infesting a large percentage of the ears. In the survey of corn insects made in August and September 1935 no field of corn in the ear stage was found in which this insect was not present. Considerable damage was also noticed to peppers and tomatoes. In the examination of several tobacco fields no earworms were noted. Some observations on the percentage of ears infested with earworms on different dates during the year are given in table 4.

TABLE 4. *Percentage of ears found infested with larvae of the corn earworm in various fields at different seasons in Puerto Rico*

DATE	LOCATION	EARS INFESTED
		Percent
1935		
August 19	Mayagüez	52.0
August 19	do.	81.0
September 23	Isabela	39.0
September 23	Hatillo	75.0
October 14	Mayagüez	56.0
October 14	Isabela	69.0
November 6	do.	43.0
1936		
January 8	Lajas	87.0
February 3	Mayagüez	27.8
May 11	Isabela	61.4
June 1	Mayagüez	55.5
June 5	Isabela	46.9

CONTROL EXPERIMENTS

Three experiments were conducted to test different methods of control for the corn earworm under Puerto Rican conditions. A randomized block arrangement was used in these experiments, the first, completed in February 1936, replicated four times, and the later experiments, completed in June 1936, replicated five times. A tropical sweet corn USDA–34, developed at the experiment station at Mayagüez, was grown for the tests. In the tests at Mayagüez and completed in February, each plot was 5 by 15 hills in size and averaged about 175 ears per treatment of four replications. In the trials completed in June 1936, plots at Mayagüez were 6 by 15 hills, with an average of approximately 350 ears for the five replications. At Isabela, where the corn was planted in drill rows, each plot consisted of a single row running the length of the field. Each plot averaged about 140 plants each and produced an average of over 500 ears per treatment in five replications.

Chemical controls consisted of insecticides applied in dust form early in the morning while the silks were moist with dew. All dusting was done by hand with a small plunger-type duster that directed the dust to the silks. In the experiment at Mayagüez, completed in February, dusting was begun near the mean silking date and continued until the silks had dried. Four applications of dust were made on December 27 and 30, 1935, and January 2 and 5, 1936. In an attempt to obtain a higher percentage of control in later experiments, applications of dust were begun as soon as a few silks appeared and continued until they dried. In the trials completed in June 1936 dusting was done as often as twice a week. Seven applications were made at Mayagüez beginning May 1 and ending May 27, and seven at Isabela beginning May 3 and ending May 24. The results are summarized in table 5.

An analysis of variance (table 6) of the three experiments gives evidence of some highly significant differences between the treatments. Differences required for significance are given in table 5. In all three trials barium fluosilicate showed a highly significant difference from the check. However, the percentages of control were not high enough to warrant its use. Derris showed significance from the check in two of the three experiments. Arsenates of magnesium and lead showed significance in only one out of three experiments, and their percentages of control were very poor. In spite of the significant reductions, none of the insecticidal materials tried gave sufficient control to be of value.

The mechanical and manual methods of control were all designed to prevent the young larvae from working down through the silks to the

TABLE 5. *Efficacy of dusts for the control of the corn earworm, Puerto Rico, 1936*

TREATMENT	TEST AT MAYAGÜEZ COMPLETED FEBRUARY 3			TEST AT MAYAGÜEZ COMPLETED JUNE 1			TEST AT ISABELA COMPLETED JUNE 5		
	EARS	EARS INFESTED	CONTROL	EARS	EARS INFESTED	CONTROL	EARS	EARS INFESTED	CONTROL
	Number	*Percent*	*Percent*	*Number*	*Percent*	*Percent*	*Number*	*Percent*	*Percent*
Barium fluosilicate and talc 1 : 1	161	11.8	57.6	361	36.3	34.6	542	30.2	35.6
Derris and talc 1 : 3	186	17.9	35.6	357	48.8	12.1	533	33.7	28.1
Magnesium arsenate and talc 1 : 4	193	22.6	18.7	339	47.2	15.0	546	33.7	28.1
Lead arsenate and talc 1 : 4	209	27.3	1.8	354	49.4	11.0	538	36.7	21.8
Check	223	27.8	—	321	55.5	—	552	46.9	—
Required significant difference for odds of 19 to 1		8.28			8.69			7.01	
Required significant difference for odds of 99 to 1		11.61			11.97			9.65	

TABLE 6. *Analysis of variance of chemical tests used against the corn earworm, Puerto Rico, 1936*

SOURCE OF VARIATION	LOCATION AND DATE OF EXPERIMENTS					
	MAYAGÜEZ FEBRUARY		MAYAGÜEZ JUNE		ISABELA JUNE	
	DEGREES OF FREEDOM	MEAN SQUARE	DEGREES OF FREEDOM	MEAN SQUARE	DEGREES OF FREEDOM	MEAN SQUARE
Blocks	3	42.51	4	22.42	4	14.25
Treatments	4	181.35*	4	244.56*	4	205.49*
Error	12	28.91	16	42.04	16	27.34

* Highly significant.

developing grain. The plots were examined twice weekly, and those ears that had silked were treated. This process was continued until the corn finished silking. The following methods were used: (1) A hog ring was clamped around the tip of the ear by the use of special pliers; (2) a piece of light-weight brown wrapping paper about 4 by 6 inches was wrapped around the tip of the ear and tied with a string to form a paper cap over the silks and ear tip; (3) a piece of No. 18 soft galvanized wire was placed around the ear tip and tightened with a pair of pliers;

TABLE 7. *Efficacy of mechanical and manual methods for the control of the corn earworm in Puerto Rico, 1936*

	TEST AT MAYAGUEZ COMPLETED FEBRUARY 3			TEST AT MAYAGUEZ COMPLETED JUNE 1			TEST AT ISABELA COMPLETED JUNE 5		
	EARS	INFESTED EARS	CONTROL	EARS	INFESTED EARS	CONTROL	EARS	INFESTED EARS	CONTROL
	Number	*Percent*	*Percent*	*Number*	*Percent*	*Percent*	*Number*	*Percent*	*Percent*
Hog rings	224	5.0	82.0	342	5.9	89.4	523	5.1	89.1
Paper caps	127	4.0	85.6	304	8.2	85.2	518	8.5	81.9
Wires	172	5.2	81.3	—	—	—	490	6.3	86.6
Strings	163	6.6	76.3	—	—	—	518	11.6	75.3
Cut silks	201	9.4	66.2	338	22.3	59.8	528	17.9	61.8
Squeezing the tips	198	14.2	48.9	336	27.2	51.0	514	23.0	51.0
Check	223	27.8	—	321	55.5	—	552	46.9	—
Required significant difference for odds of 19 to 1		7.26			6.48			3.43	
Required significant difference for odds of 99 to 1		9.95			8.92			4.65	

(4) a piece of string was tied around the ear in a similar manner; (5) the silks were cut off with a pair of scissors; and (6) the tips of the ears were squeezed by hand. Care was exercised in applying those methods that might interfere with pollination. In the application of hog rings, strings, and wires, room enough for the ear to develop was allowed. Results of the mechanical and manual methods are presented in table 7.

Analysis of the data by the variance method (table 8) shows that there are some highly significant differences among the treatments, and the amounts by which two treatments must differ to be significant are

shown in table 7. It will be noted that all the treatments showed highly significant differences from the check in all the experiments. Hog rings gave the best control in two out of three trials, with the wires, paper caps, and strings nearly as good. By the use of special pliers the hog rings could be applied more rapidly and easily than the other treatments, and under labor costs in Puerto Rico at about $15 for an acre of 8,000 ears. Cutting the silks, after pollination, showed a reduction of infestation over the check, but the tips of the ears thus exposed became ideally suited to oviposition by the fly *Euxesta stigmatias*, and as a result large numbers of ears so treated became maggot infested. The materials for the paper caps were cheap but the labor necessary in their application increased their cost. The applications of strings would cost approximately $9.47 per acre of 8,000 ears. With a good market price for sweet corn, the use of some of these methods would be feasible. It is possible that a lighter, cheaper ring could be substituted for the hog ring at a lower cost. All these methods of protection gave such encouraging results that they should be further investigated.

TABLE 8. *Analysis of variance of mechanical and manual methods used for the control of the corn earworm in Puerto Rico, 1936*

SOURCE OF VARIATION	LOCATION AND DATE OF EXPERIMENTS					
	MAYAGÜEZ FEBRUARY		MAYAGÜEZ JUNE		ISABELA JUNE	
	DEGREES OF FREEDOM	MEAN SQUARE	DEGREES OF FREEDOM	MEAN SQUARE	DEGREES OF FREEDOM	MEAN SQUARE
Blocks.....	3	25.33	4	10.13	4	16.08
Treatments.	6	286.39*	4	1,974.72*	6	1,077.23*
Error.....	18	23.90	16	23.37	24	6.90

* Highly significant.

SUMMARY

Investigations of the corn insects of Puerto Rico were made during the period extending from August 1935 to June 1936. Four species of insects were found of importance to the corn crop of the island, viz, the corn leafhopper, the otitid fly *Euxesta stigmatias*, the fall armyworm, and the corn earworm.

Three experiments were conducted with dusts against the fall armyworm. In these lead arsenate gave the best results, with control up to

88.2 percent. Barium fluosilicate was less satisfactory. Some improvement appeared to be gained from dusting at weekly rather than at 10-day intervals.

Chemical, mechanical, and manual methods were tried against the corn earworm. Of the chemicals, barium fluosilicate gave the best control, but burned the plants severely. Although some significant degrees of control were obtained, none of the insecticides gave encouraging results against the corn earworm. Mechanical and manual methods designed to prevent the larvae from working from the silks to the grain gave good results. The application of hog rings, paper caps, strings, and wires all gave substantial control. Because of the promising results obtained, these methods would appear to be worthy of further study.

NEW BIRD RECORDS AND SOME NOTES FOR THE VIRGIN ISLANDS

By Harry A. Beatty

Christiansted, St. Croix, V. I., U. S. A.

This paper is an account of observations and collections I made on St. Croix, St. Thomas, St. John, Tortola, Virgin Gorda and numerous small outlying islands and cays.

In this account I have included species which were previously recorded from the Virgin Islands but are now placed on record for the first time as breeding birds. Among the rare finds was the discovery of a small colony of nesting Blue-faced Booby (*S. d. dactylatra*).

It seems highly improbable that the Quail-dove, *Oreopeleia montana montana,* at one time winged its way through the jungles of St. Croix. If that were true then we ought, perhaps, to assume that the species disappeared some time during the short period of sixty years and another form emerged upon the scene and today has become fairly common. My desire to take specimens of *montana* has spurred me on to find it here since 1918. A search on St. Thomas for *montana* has likewise been unsuccessful. I looked for it during a total time of six weeks over a three year period on six different trips. Peters, in his Check-list of Birds of the World, Vol. 3, makes no mention of any St. Croix record and indicates that the record for St. Thomas is questionable. However, if it does occur there it must be extremely rare while today *O. m. beattyi* is the prevalent form although an extremely shy bird due in greater part, no doubt, to the continuous persecution by gunners. The Quail-dove on St. Croix is an unsuspicious bird not harassed by gunners and well protected by sentiment and legislation.

On Tortola, B. V. I., the Quail-dove is unknown by all its familiar names. The natives will insist that they know only of a "Marmee-dove" in the woods. On March 13, 1941, while on a visit to that island, eight birds came under observation and several specimens were taken. All were of one species. I also learned that the Marmee-dove is very uncommon and greatly restricted in its range. On Virgin Gorda I searched an entire afternoon on April 22nd for the Quail-dove, ever on the alert to catch a song, but nothing was heard nor seen of it.

Puffinus lherminieri lherminieri.—Audubon Shearwater. Little Saba Cay: March 10, 1941. Eggs in nest-holes. April 16, 1941. Downy young in nests. A number of adults were taken from nest-holes and prepared as skins, among them were 5 males and 5 females. I cite this species to record the observation that both sexes shared in the incubation. Each bird collected was sitting on an egg. Later, the downy young alone were occupying the nest-holes.

Phaethon aethereus mesonauta.—Red-billed Tropic-bird. Cockroach Cay: Two pairs, nesting in cliffs, were observed first on March 11th and again on April 17, 1941. On Virgin Gorda two pairs were nesting in cliffs west of Gorda Sound, April 22, 1941.

Phaethon lepturus catesbyi.—Yellow-billed Tropic-bird. Little Saba Cay: An immature was taken from its nest on April 16, 1935. Water Island: March 21, 1941, ten pairs were nesting in high cliffs. Dutchmans Cap: July 11, 1940, a pair was seen taking food to a young bird on the rocks. Virgin Gorda, April 22, 1941. Two pairs were nesting in cliffs at Gorda Sound.

Sula dactylatra dactylatra.—Blue-faced Booby. Cockroach Cay: April 17, 1939. Four adults were seen, one bird occupying an unlined nest containing two eggs. March 30, 1940, I saw eight adults and a nest occupied by one snow white downy young. On July 12, 1940, ten adults were seen; a nest with one egg and another with one big fluffy downy. On March 11, 1941, I saw ten adults and two nests containing two eggs each guarded by adults. Another nest held a very big fluffy nestling with which I played at "pecking" while the parent bird nestled up close and looked on approvingly. One immature was seen on the wing.

Fregata magnificens rothschildi.—Frigate-bird. Little Tobago Cay: March 13, 1940. I visited the cay for data but rough seas made landing impossible. About 200 adults and many white headed immatures were on the wing. Local fishermen tell me that nesting begins about January.

Circus cyaneus hudsonius.—Marsh Hawk. St. Croix: A new record was added to the fauna when fifteen of these hawks were seen on November 2, 1940. Each bird was in the brown phase and several of them could be seen daily until April 16, 1941. A specimen was taken on November 9, 1940, and another on January 15, 1941.

Pandion haliaetus carolinensis.—Osprey. St. Thomas: Mr. Nichols tells me that he had seen two nestlings which he recognized as this species. They had been removed from a nest on the cliffs of an unidentified cay somewhere in the Tortola area. The time was about March in 1940.

Falco peregrinus peregrinus.—European Duck-hawk. St. Croix: At dusk, November 9, 1940, I collected a Duck-hawk. The specimen was included in a package of skins sent to Dr. Louis B. Bishop. Dr. Bishop has written to tell me that he considers it to be the European Falcon. This is a new record for St. Croix, and for the West Indies.

Oxyechus vociferus rubidus.—Antillean Killdeer. St. Croix: The antillean killdeer was first recorded on September 26, 1939. A pair caring for two downy young was seen on October 28, 1939, and again on February 10, 1941, another pair was found with three downy. This is a first record for the island.

Ereunetes mauri.—Western Sandpiper. St. Croix: Several specimens were taken in August and September, 1939. A new record.

Larus atricilla.—Laughing Gull. Flat Cay: June 26, 1940, a colony of 100 adults, 10 nests of three eggs each.

Gelochelidon nilotica. Gull-billed Tern. Cockroach Cay: July 12, 1940, about 50 birds occupied a ridge and I counted ten nests with two downy young in each. The nests were cups in a bed of short grass quite close to a nesting colony of Royal Terns.

Sterna hirundo hirundo.—Common Tern. St. Croix: On September 26 and again on October 15, 1939, a flock of eighteen common terns was encountered on their feeding grounds two miles offshore. I collected two specimens, one of which had been banded on June 9, 1938, at Penikese Island, Massachusetts, by Dr. O. L. Austin. This is a new record.

Sterna dougallii dougallii.—Roseate Tern. St. Thomas: A colony of 200 nested on coastal cliffs at Bivoni Bay and had downy young on June 26, 1939. At Little Saba Cay a colony of 200 was found nesting on the cliffs on July 2, 1940.

Sterna anaethetus melanoptera.—Bridled Tern. Flat Cay and Little Saba Cay: A colony of 200 birds were nesting and downy young and some eggs were noted on June 26, 1940. Each nest contained a single egg placed on bare earth under shrubbery.

Sterna fuscata fuscata.—Sooty Tern. Dove Cay, Flat Cay, Little Saba Cay: A colony of 100 terns was caring for downy young and incubating late eggs on June 26, 1940. The single egg in each nest was resting on bare earth under protective shrubbery.

Thalasseus maximus maximus.—Royal Tern. Cockroach Cay: July 12, 1940. A colony of 40 adults was found caring for downy young having either one or two young in each nest.

Anous stolidus stolidus.—Noddy. The noddy starts nesting early in June. Colonies of from 100 to 500 birds were found nesting on Cock-

roach, Little Saba, Flat Cay and Ginger Island. The single egg is deposited on the bare rock-ledge, usually in a cliff facing.

Oreopeleia mystacea beattyi.—Quail-dove. St. John: March 13, 1940. Several specimens were collected. This is a new discovery in the fauna of the island. Tortola, B. V. I.: March 15, 1941. Specimens taken also constitute a new discovery for Tortola and will likely prove to be the most easterly limits in the range of *beattyi.*

Protonotaria citrea.—Prothonotary Warbler. St. Croix: A male was collected on October 6, 1940. Grange Swamp. A new record.

Helmitheros vermivoros.—Worm-eating warbler. St. Croix: On October 31, 1940, two specimens were taken on Mt. Eagle, and another was seen on April 9, 1941. A new record.

Dendroica breviunguis.—Black-poll Warbler. St. Croix: About fifteen of these warblers were observed in an extensive field overgrown with thorny acacia, first on October 23, 1940, and thereafter at intervals for two weeks. Several specimens were taken. A new record.

Dendroica discolor collinsi.—Florida Prairie Warbler. St. Croix: Among a number of warbler skins sent to Dr. Bishop was one specimen which he identified as this form. It was taken on October 24, 1940. A new record.

Wilsonia citrina.—Hooded Warbler. St. Croix: A male bird was collected on March 16, 1941. It was flitting amongst undergrowth following a streamway when first observed. This is a new record.

ACKNOWLEDGMENTS

On all my visits to the islands and cays in the Virgin Islands group the greatest difficulty was transportation. For assistance in making these arrangements and other courtesies it is a pleasure to mention my gratitude to various people.

To The Honorable Robert M. Lovett, Acting Governor of the V. I., U. S. A., for his kindly interest in my plan to continue scientific investigations of local faunas. Mr. M. F. de Castro, Commissioner of Finance, expedited the issuance of collecting permits. Mr. D. Boreham, Superintendent of Public Works, gave material assistance on several occasions. Norman Grigg gave unstintingly of his time and captained his very seaworthy power-boat on several trips, adding greatly to the success of sea bird collecting. Mr. R. Nichols, Director of the Extension Station, also assisted me and his knowledge of local birds was of value. I was very much impressed by the excellent collection of eggs of Virgin

Islands birds which Mr. Nichols has brought together. Among them is a set of three eggs of the rare little owl, *Otus nudipes newtoni*, collected on St. Thomas in May 1936. The eggs are snowy white in color. I shall remember the kindnesses of Dante de la Garde who stands alone in the interest of conservation on that island. He needs cooperation if the ruthless traffic in eggs and, especially, the young of all sea birds and game birds is to be stamped out. Thanks are due Desmond Fabio for his hospitality and much oral information about the cays.

I must mention His Honour D. P. Wailing, Commissioner of Tortola, B. V. I., for his gracious consent in granting permits for collecting on that island and his deep interest in my findings. And Mr. Roy, Director of the Botanical Station, who joined me on several excursions, his knowledge of the island and of the people rendering collecting a simpler task.

Special thanks are due Senor V. Balbas Peña, of San Juan, for an invitation to join a party of friends vacationing among the islands on his motor cruiser *"Malola."* During the trip there were abundant opportunities for ornithological observations in which I was ably assisted by the enthusiasm and alertness of shipmates Julio Rodriguez and Guillermo Margaridas, of San Juan, and Anton C. Teytaud, of St. Croix.

NEW COLEOPTERA FROM PUERTO RICO

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Among a small collection of Coleoptera submitted for identification from Puerto Rico by George N. Wolcott, the following two interesting new species were found. L. F. Martorell, who is making an insect pests survey of the forest trees of Puerto Rico, is anxious to have names for the species to be used in a paper dealing with the insects of that region.

Family ANOBIIDAE

Catorama neltumae, new species

Oblong-oval, strongly convex, moderately shining, uniformly black above, slightly more brownish beneath, with the antennae and tarsi yellowish, rather densely clothed with short, recumbent, more or less silky, whitish pubescence, which does not conceal the surface. Head and pronotum confluently punctate, with fine and coarse punctures intermixed. Elytra finely, densely punctate, with numerous, irregularly arranged, coarse punctures; each elytron with two rather deep lateral striae extending from middle of elytron to apex, but obliterated basally. Anterior tibia unisulcate externally. Middle tibia without a marginal groove. Metasternum not carinate anteriorly, rather sparsely, coarsely, uniformly punctate over entire surface.

Length 3.5 mm., width 2 mm.

Type Locality.—Guanica, Puerto Rico.

Type and Paratypes.—In the United States National Museum No. 55676. Paratypes in the Agricultural Experiment Station, Rio Piedras, Puerto Rico.

Described from ten specimens collected during December 1940 from seed pods of mesquite, *"Neltuma juliflora,"* by L. F. Martorell (P. R. Acc. No. 812–40).

This species is related to *Catorama herbarium* Gorham but differs from that species in being uniformly black on the dorsal surface of the body, in having the pubescence on the pronotum and elytra finer and

more silky, the punctures on the elytra irregularly distributed and not arranged in rows, the lateral striae extending only to the middle of the elytron, and the anterior tibia with only one longitudinal sulcus.

FAMILY CERAMBYCIDAE

Trypanidius nocturnus, new species

Female.—Broadly elongate, moderately convex above, uniformly dark reddish brown, the elytra ornamented with black and yellowish-white pubescent markings.

Head in front flat, longer than wide, rather broadly concave between the antennal tubercles, which are widely separated and slightly elevated; surface finely, densely punctate, densely clothed with short, recumbent, brownish and yellowish pubescence, with a distinct longitudinal groove extending from occiput to clypeus. Eyes large, not coarsely granulated, deeply emarginate, separated from each other on the top by about one-half the width of the emargination of the eye; lower lobe subquadrate; upper lobe narrow. Antenna as long as body, densely clothed with short, recumbent, brownish pubescence, with a few inconspicuous white hairs intermixed, the segments narrowly annulated with whitish pubescence at bases; first segment slender, subcylindrical, gradually expanded to apex, extending to base of pronotum, one-fourth longer than third segment, which is distinctly longer than fourth.

Pronotum distinctly wider than long, slightly narrower at apex than at base, widest at middle; sides obliquely expanded from apical angles to a short, acute tubercle on each side just behind middle, then obliquely converging to the posterior angles; surface moderately convex, slightly uneven, broadly, transversely depressed along base, with a slightly elevated, rounded gibbosity at middle, in front of which is a round depression, and with a transverse row of coarse, deep punctures in basal depression, densely clothed with short, recumbent, dark-brown and yellowish-brown pubescence, and ornamented with five brownish-black pubescent spots, one median and two on each side. Scutellum elongate-triangular, slightly concave, densely clothed with brownish-black pubescence at sides.

Elytra distinctly wider than pronotum; sides gradually, obliquely converging from humeral angles to apical fifth, then strongly, arcuately converging to the tips, which are separately obtusely angulated; surface sparsely, coarsely, irregularly punctate basally, more finely, sparsely apically, densely clothed with short, recumbent, dark-brown and yellowish-brown pubescence, with longitudinal rows of inconspicuous white pubes-

cent spots. Each elytron ornamented with a slightly oblique black pubescent spot along sutural margin behind scutellum, and a similar colored, narrow, arcuate one behind middle, and with a narrow, short, longitudinal, yellowish-white pubescent vitta at base and a large, triangular, yellowish-white pubescent spot covering apical fourth.

Body beneath finely, indistinctly punctate, rather densely clothed with short, recumbent, inconspicuous pubescence, with numerous irregular, yellowish pubescent spots; last abdominal sternite broadly subtruncate at apex; prosternal process one-half as wide as coxal cavities, nearly flat at middle, with sides slightly elevated; mesosternum as wide as coxal cavities, broadly triangular, sides elevated, declivous in front, slightly emarginate posteriorly; femora strongly clavate.

Length 15 mm., width 6 mm.

Type Locality.—Villalba, Puerto Rico.

Type.—In the United States National Museum, No. 55677.

Described from a single female collected at light, May 18, 1940, by L. F. Martorell (P. R. Acc. No. 789–40).

This species is allied to *Trypanidius insularis* Fisher described from Cuba, but differs from that species in being more reddish brown and in having a large, triangular, yellowish-white pubescent spot covering the apical fourth of each elytron replacing the transverse, white, zigzag fascia on the elytron of *insularis*.

STUDIES ON THE MOSAIC OF PEPPERS (*CAPSICUM FRUTESCENS*) IN PUERTO RICO

By Arturo Roque and José Adsuar

Introduction

A mosaic disease of peppers causing stuntiness of the plant and severe malformation of the fruit appeared in epidemic form about three years ago in the Agricultural Experiment Sub-station at Isabela. Since then it has spread with great rapidity and intensity throughout that region and has also been found causing serious damage in other important vegetable sections of the island. Serrano and Riollano (6) estimated the crop losses due to mosaic for Isabela from 50 to 60 percent in the season of 1938 and stated that further plantings were, in their opinion, a risky proposition.

The first report of pepper mosaic in Puerto Rico known to the writers is that made by Cook (2) in 1927–28. Since then, no effort has been made to study the disease and to determine the virus or viruses involved.

In connection with a breeding program to develop a commercial variety of peppers resistant to mosaic, studies to determine the prevalence, distribution, properties of the virus and varietal susceptibility were undertaken. The experiments were conducted in the Agricultural Experiment Station at Rio Piedras during the years 1939–41.

Materials and Methods

All plants used for inoculation purposes were grown in sterilized compost soil in 5 inch pots. The plants were kept in a section of the greenhouse screened with 24-mesh copper wire. As an additional precautionary measure the plants were periodically sprayed to prevent, as far as possible, accidental infections due to insect vectors. Inoculations were made when the plants had developed 3 or 4 pairs of leaves and were actively growing. Although the ordinary methods of mechanical transmission were found satisfactory, the brush method was developed and adopted for its practicability. This method consists in the use of a flat artist brush (Mikado No. 5) with bristles cut to a length of about ½ inch. The brushes can be used over and over again after sterilization

in boiling water for fifteen minutes or more and are very convenient for large scale inoculations. Inoculations were performed by gently rubbing the upper surface of two or three of the youngest leaves with a brush that had been dipped in the extract.

The inoculum was obtained by crushing infected leaves in a sterile mortar with sterile sand and water. The resulting macerate was strained through cheese cloth and used without further treatment.

FIG. 1. Young pepper plants of the variety King of the North showing symptoms of pepper mosaic. Plants at left and right inoculated; middle plant, check. Note stunting, mottling and malformation of infected plants.

The longevity "in vitro" was determined by aging the extract in stoppered test tubes for the desired length of time. The thermal inactivation point was determined by immersing 5 cc. of the extract in thin walled test tubes in a water bath.

Pure cultures of the viruses, for inoculation and other studies, have been kept in young pepper and tobacco plants grown in cages. The potato mottle virus (ring spot strain) and the potato vein banding virus were kindly supplied by Prof. J. Johnson of Wisconsin University. The ordinary tobacco mosaic virus and the cucumber mosaic virus were obtained locally from infected tobacco and cucumber plants.

The commercial varieties of peppers California Wonder and Large Bell Hot, the variety Mirasol (a South American hot pepper) and *Nicotiana glutinosa* were used as differential hosts in these studies.

All inoculations were repeated at least three times in lots of ten plants.

The insect transmission studies were conducted by submitting healthy pepper plants grown free from insects to the attack of aphids feeding on plants inoculated with the pepper mosaic virus.

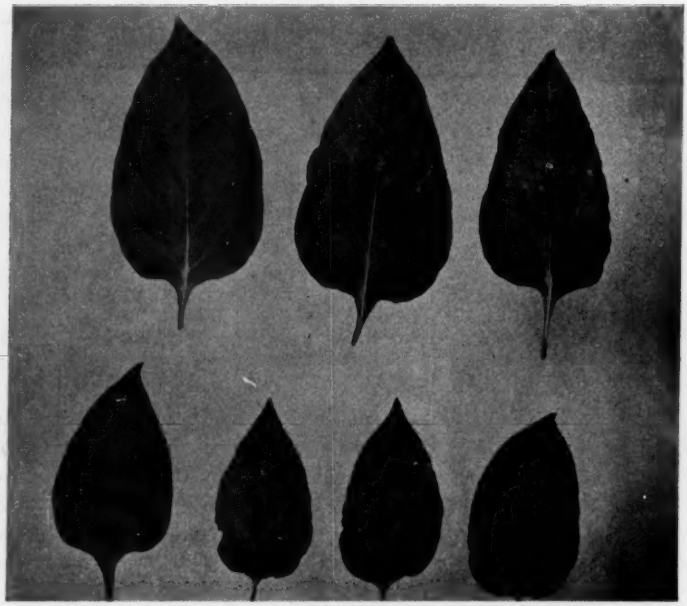

FIG. 2. Infected leaves of two varieties of pepper showing characteristic symptoms of pepper mosaic. Upper and lower left leaves uninoculated. Note vein-clearing, mottling and vein-banding.

The immunological relationship between the pepper mosaic virus and other viruses was determined by inoculating the Large Bell Hot variety with the following: Solanum 1 and 2, ordinary tobacco mosaic and cucumber mosaic viruses. After symptoms appeared, the affected plants were reinoculated with the pepper mosaic virus.

SYMPTOMS

All susceptible varieties of pepper studied with the exception of the Large Bell Hot, present the following symptoms when infected with the virus causing mosaic: in about 10–12 days after inoculation a marked clearing of the veins develops in the upper younger leaves, followed later by a systemic mottling which, in a majority of cases, ends in a definite vein banding. This last symptom is very characteristic of the mosaic produced by this virus and helps to identify it in the field. In addition

FIG. 3. Young pepper plants of the Large Bell Hot variety inoculated with pepper mosaic virus. Left and right plants inoculated; middle plant, check. Note systemic vein necrosis and leaf shedding.

to the mottling, the leaves become wrinkled and the whole plant is stunted, especially if the infection has taken place early in the development of the plant. Fruit setting is curtailed and those that develop after the symptoms have appeared are undersized, mottled and badly distorted.

The severity of the disease bears a relation to the age of the plants at the time of inoculation—young plants are more seriously and rapidly affected than old plants.

The variety Large Bell Hot is a hot pepper of medium, square shaped fruits. In young, actively growing plants of this variety the virus pro-

duces a systemic vein necrosis in from 5–6 days, followed by defoliation, stem streaking and death of the entire plant. These symptoms develop more slowly in the old plants. The characteristic mottling and vein banding do not develop. As no other variety so far studied reacts in this way to this virus, it serves as an excellent host for identification purposes as well as for other studies.

FIG. 4. Young pepper plants of the Large Bell Hot variety inoculated with pepper mosaic virus showing advanced stage of the infection. Left and right plants inoculated; middle plant, check. Note defoliation, stem streaking and death.

DISTRIBUTION AND PREVALENCE

The disease is widely spread throughout the island and has been found in almost every place where peppers are grown.

The prevalence of the virus in fields infected with mosaic was determined by sampling at random diseased plants and inoculation into the "Mirasol" variety of pepper. The variety "Mirasol" was used because it reacts with localized necrosis to the *Nicotiana* virus 1, thus differentiating between the virus under study and the ordinary tobacco mosaic virus which is widely distributed throughout the island. In seven areas surveyed, its presence ranged from 60 to 95 percent in the plants with mo-

saic. Tobacco mosaic was found on three of the seven areas and only to an extent of from 1–3 percent of the diseased plants.

PROPERTIES OF THE VIRUS

Transmission.—Transmission is easily accomplished by the usual mechanical methods. Evidence of transmission by the aphids *Myzus persicae,* Sulz., has also been obtained.

Aging "in vitro."—Freshly prepared extract stored in test tubes at a room temperature of 22° C., kept its infectivity up to 24 hours and was completely inactivated after 48 hours.

Thermal Inactivation.—To determine the heat resistance of the virus, 5 cc. of the extract was placed in thin test tubes and heated in a water bath at the desired temperature for 10 minutes. The heated extract was rapidly cooled in iced water and immediately inoculated in the test plants. Infections were obtained with extract heated up to 55° C., but no reaction was obtained with extract heated to 58° C. or more.

Dilution.—The effect of dilution on the infectivity of the virus was determined by diluting the fresh extract with sterile water. The dilution end point is low, infectivity begins to fall rapidly at dilutions of 1–80 and infections were only occasionally obtained at dilutions of 1–100.

IMMUNOLOGICAL RELATIONSHIPS

To determine the possible relationship between the virus responsible for the pepper mosaic in Puerto Rico and such common viruses as the tobacco virus 1, cucumber virus 1 or their strains, and viruses of the Solanum group 1 and 2 which are known to attack peppers in nature, cross inoculation studies were made. The variety of pepper Large Bell Hot, because of its typical systemic vein necrosis reaction was used. Plants reacted as follows when inoculated: chlorosis and mottling with ordinary tobacco mosaic and cucumber viruses, mottling with Solanum virus 1 and localized necrotic spots with Solanum virus 2.

The results demonstrated that the four above mentioned viruses were unable to immunize or protect invaded tissues of the Large Bell Hot pepper against infection by subsequent inoculation with the virus under study.

HOST RANGE

In an attempt to determine if the virus was limited in its range to the genus *Capsicum* and at the same time to study its host relationships

within the *Solanaceae,* efforts to reproduce the disease in other members of this family were made. Out of eighty-four varieties of the genus *Capsicum,* including commercial and non-commercial varieties, only two have been found resistant to the virus. A strain of pepper developed by Dr. F. O. Holmes * which reacts with localized necrotic spots when inoculated with the tobacco mosaic virus, reacts with systemic mottling to the Puerto Rico pepper mosaic virus. Among related genera, *Nicotiana glutinosa, N. Tabacum,* var. Virginia, *N. Bigelovii,* var. *multivalvis, N. Bigelovii* var. *quadrivalvis* and *N. rustica,* developed symptoms when inoculated with the new virus (See Table I). *Solanum melongena* var.

TABLE I. *Symptoms developed on different hosts by the Puerto Rico pepper mosaic virus when inoculated artificially*

HOST	SYMPTOMS
Capsicum frutescens, var. Large Bell Hot	Vein clearing, systemic vein necrosis, defoliation, stem streak, death
C. frutescens, var. California Wonder	Vein clearing, mottling, vein banding, stuntiness
Nicotiana glutinosa	Chlorosis, vein clearing, mottling
N. Tabacum, var. Virginia	Vein clearing, chlorotic spots, vein banding
N. Bigelovii, var. *multivalvis*	Vein clearing, ring spots
N. Bigelovii, var. *quadrivalvis*	Vein clearing, ring spots
N. rustica	Vein clearing, mottling, vein banding

Puerto Rican Beauty and *Lycopersicum esculentum,* var. Marglobe, occasionally developed symptoms, but failed to indicate the presence of the virus when tested back to a differential host like the Large Bell Hot pepper. *Solanum tuberosum, S. nodiflorum, Datura stramonium, N. sylvestris,* and *N. repanda* failed to develop symptoms when inoculated. *Cucumis sativus, Phaseolus vulgaris* and *Phaseolus lunatus* did not react to the virus.

DISCUSSION

The nature of the virus causing pepper mosaic in Puerto Rico is not known. A study of the literature dealing with pepper mosaic reveals that several viruses are capable of infecting the genus *Capsicum* in nature.

* Seed of this strain, a semi-commercial variety of peppers, was kindly supplied by F. O. Holmes of the Rockefeller Institute for Medical Research, Princeton, N. J.

J. Johnson (5) described eight out of eleven viruses studied as causing definite symptoms in peppers. Blodgett (1) was able to produce a serious disease of peppers by inoculating with the virus causing mottle in tobacco (Solanum 1). E. M. Johnson (4) found peppers susceptible to eighteen of the viruses attacking tobacco in Kentucky. K. M. Smith (7) listed eight viruses capable of infecting peppers. Holmes (3) recorded twelve pathogenic viruses on peppers. A comparison of the properties and symtoms of the viruses causing pepper mosaic elsewhere and the one from Puerto Rico is presented in the following table.

With the possible exception of the potato vein banding virus (virus Y), the viruses reported differ widely from the Puerto Rico pepper virus not only in physical properties, but in many cases in symptoms as well. The vein banding virus, however, is very similar in physical properties to the virus here reported. The symptomatology, nevertheless, is very different from that produced by our virus. In the Large Bell Hot variety the vein banding virus produces necrotic spots, wrinkleness and blight while the pepper virus produces a distinct systemic vein necrosis which is always fatal. The difference in symptom expression, however, is not sufficient in itself to establish relationship between the viruses.

Plants of the Large Bell Hot variety inoculated with the vein banding virus and showing symptoms were reinoculated with the virus causing pepper mosaic in Puerto Rico. The typical systemic vein necrotic symptoms of this differential host developed, showing that the former virus offered no protection to infection by our virus and, therefore, that the two viruses were not closely related.

As far as the writers know the potato mild mosaic virus (potato virus A) has not been reported attacking peppers. Its physical properties, however, closely resemble those of the pepper virus from Puerto Rico and since the symptoms described on *N. tabacum* are also similar it may be possible that they might be related. Unfortunately, the writers have been unable to obtain a pure culture of this virus for comparative studies.

With the possible exception of the ordinary tobacco mosaic virus, no other virus has been reported causing serious and widespread damage to commercial plantings of peppers. The virus here reported, however, causes a disease of considerable importance in our commercial fields and is widely distributed in Puerto Rico. All commercial varieties of peppers so far tested and a large number of non-commercial, ornamental and hot types are susceptible to this virus. It thus appears, that the virus,

TABLE II. *Symptoms and properties of the viruses reported as capable of infecting peppers*

VIRUS	SYMPTOMS ON *Capsicum frutescens*	PHYSICAL PROPERTIES			IMMUNOLOGICAL REACTION WITH PUERTO RICO PEPPER MOSAIC VIRUS
		AGING	THERMAL DEATH-POINT	DILUTION	
Puerto Rico pepper mosaic virus	Mottling, vein banding, stuntiness, distortion	24–48 hrs.	55° C.–58° C.	1–100	
Tobacco mosaic virus—Typical strain	Chlorosis, mottling, necrosis, stuntiness	Indefinite	93° C.	1–1,000,000	Negative
Tobacco mosaic virus—Masked symptom strain	Mottling	Indefinite	90° C.	1–1,000,000	Undetermined
Tobacco Etch virus—Typical strain	Mottling, chlorosis, stuntiness, distortion	—	—	—	Undetermined
Cucumber mosaic virus—Typical strain	Malformation, chlorosis, stuntiness	72–96 hrs.	60° C.–70° C.	1–10,000	Negative
Cucumber mosaic virus—Southern celery mosaic strain	Mottling, necrosis, stuntiness	14 days	75° C.–80° C.	1–100,000	Undetermined
Cucumber mosaic virus—Lima bean mosaic strain	Stuntiness, chlorotic spots	8 days	70° C.	1–10,000	Undetermined
Cucumber mosaic virus—Potato vein banding strain	Necrotic spots, wrinkleness, leaf blight	24–36 hrs.	52° C.	1–100	Negative
Potato mottle virus—Typical strain	Chlorotic spots, necrosis defoliation	Over 28 days	70° C.	1–100,000	Undetermined
Potato mottle virus—Potato ring spot strain	Systemic necrosis	Over 28 days	68° C.	1–10,000	Negative
Potato mottle virus—Masked mottle strain	Systemic necrosis	—	—	—	Undetermined
Potato Aucuba mosaic virus	Chlorotic spots, mottling distortion, leaf drop	Less than 4 days at 15° C.	65° C.	1–200	Undetermined
Tomato spotted wilt virus—Typical strain	Mottle	Less than 5 hrs.	42° C.	1–100,000	Undetermined
Tomato streak virus	Mottling, chlorosis	Indefinite	85° C.–90° C.	—	Undetermined
Tomato ring mosaic virus	Chlorotic rings, distortion, stuntiness	—	80° C.	—	Undetermined
Tomato bunchy top virus	Symptomless carrier	12–24 days	70° C.	—	Undetermined
Sugar Beet curly—top virus	Vein clearing, curling	Over 7 days	75° C.–80° C.	1–1,000	Undetermined

although successfully transmitted to other members of the *Solanaceae,* is largely confined to the genus *Capsicum* in Puerto Rico.

Based on a survey of the literature available and the evidence presented, the virus under discussion may be some described form thus far not reported attacking peppers, or an entirely undescribed entity.

SUMMARY

A serious mosaic disease of peppers in Puerto Rico is reported. The disease is widely spread throughout the island and causes mottling of the foliage, stuntiness of plant and malformation of the fruit.

The virus responsible for the disease is easily transmitted mechanically. Evidence of transmission by the aphid *Myzus persicae* has been obtained. The virus is inactivated "in vitro" after 48 hours. The thermal inactivation point ranges from 55° to 58° C. Infectivity falls rapidly at dilutions of 1:80 and infections are only occasionally obtained at dilutions of 1:100.

No immunological relationship was found between the virus causing mosaic of peppers in Puerto Rico and the potato mottle virus (ring spot strain), the potato vein banding virus, the ordinary tobacco mosaic virus and the cucumber mosaic virus.

Out of eighty-four varieties of peppers studied only two were found resistant to the virus. *Nicotiana tabacum, N. glutinosa, N. Bigelovii* var. *multivalvis, N. Bigelovii* var. *quadrivalvis,* and *N. rustica* reacted when inoculated with the virus. *Solanum nodiflorum, S. tuberosum, Datura stramonium, Nicotiana repanda* and *N. sylvestris* failed to develop symptoms when inoculated. *Cucumis sativus, Phaseolus vulgaris* and *P. lunatus* did not react to the virus.

The studies suggest that the virus causing pepper mosaic in Puerto Rico is either a described form thus far not reported attacking peppers, or an undescribed entity.

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GERMINATION FAILURES OF THE MAGNOLIA IN PUERTO RICO

By Melville T. Cook

During the summer of 1936 Mr. L. R. Holdridge of the U. S. Forestry Service called my attention to germination failures of *Magnolia portoricensis* Bello. This and the very closely related species *M. splendens* Urban produce exceptionally fine woods but unfortunately both species are being exterminated very rapidly. Both species were very abundant at one time but at the present, it is practically impossible to find young trees in the forest. The Forestry Station has been trying to overcome his difficulty by sowing seeds in seed beds and growing seedlings for transplanting. Up to the present only one seedling of *M. borinquensis* has been produced although thousands of seeds have been sown.

When the first lot of material was brought to the writer it was found that the seeds in the pods were surrounded by masses of a white fungus mycelium and appeared to be packed in cotton. It was very naturally assumed that this fungus might be the important factor in the poor germination. The seeds from these pods were found to be dead but the fungus could not be detected on the inside.

However, it was noted that many seeds had never matured. Some of them were very small black scales, while others had attained a somewhat larger growth and then stopped before attaining full size. Therefore it was decided to make a study of the development of the embryo sac and embryo. A large number of seeds were sectioned in paraffin.

It was found that many of these ovules never developed an embryo sac. Others developed empty sacs. Whether they were really empty or appeared so as a result of faulty technique has not been determined. Most of the large seeds developed large sacs which were filled with an endosperm but the development has not been traced. Only three embryos have been found and in all cases the seeds were in an advanced stage of development and the two small embryos were in much larger seeds than the large embryo.

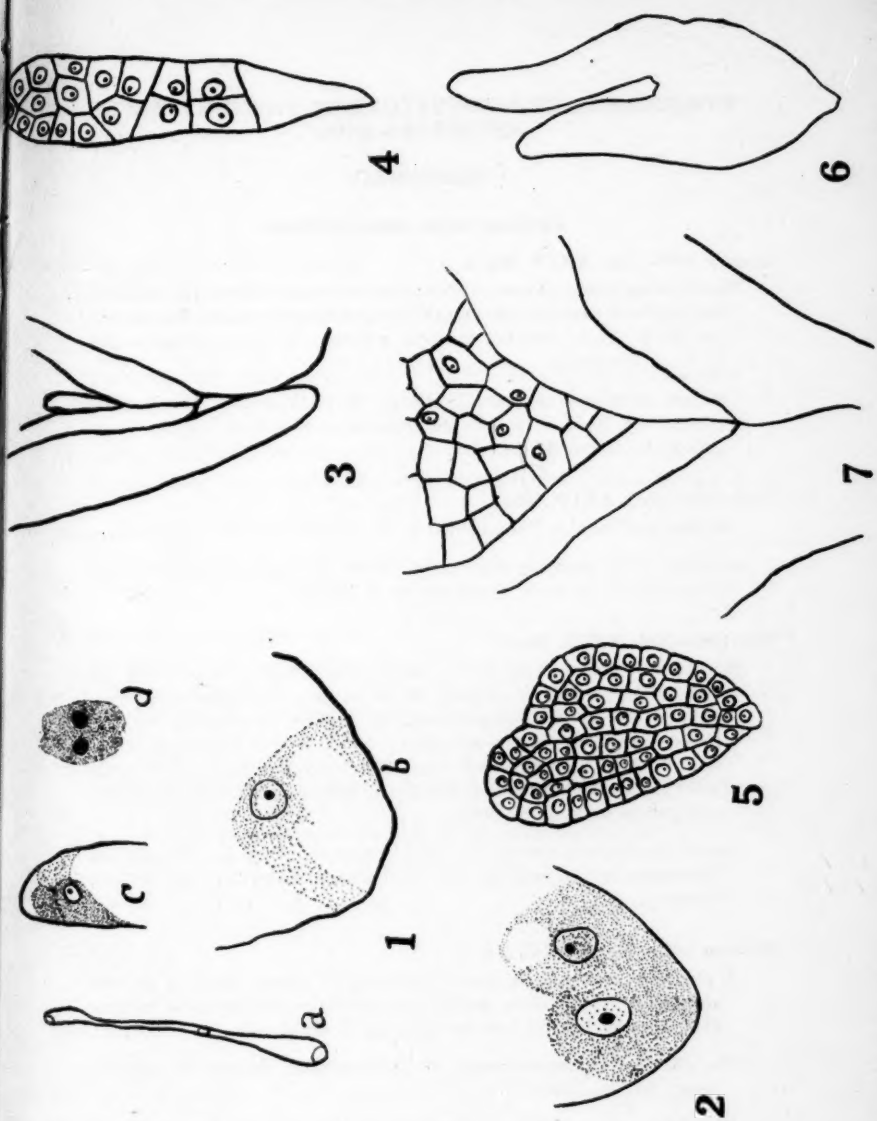
The pollen appeared to be normal.

The *M. splendens* has not been studied by the writer but young trees are as rare for this species as for *M. portoricensis.*

This problem presents several questions. Why are such a small number of embryos produced? Undoubtedly the behavior of this species must have been quite different in the past otherwise it could not have been as abundant as it has been until very recently. It lost the power of producing viable seeds? If so, why?

EXPLANATION FOR FIGURE ON PAGE 53

1. Embryo sac about ½ length of ovule.
2. Egg from same immersion.
3. Ant from same immersion.
4. Polars from same immersion.
5. Egg and one synergid.
6. Embryo in position.
7. Embryo in position.
8. Embryo in position.
9. Embryo in position.
10. Micropyle end of large seed almost mature. There is no embryo but the entire embryo sac was filled with a mass of endosperm.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